PROCEEDINGS

OF

THE ROYAL SOCIETY.

1843–44. No. 59.

December 7, 1843.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

The Minutes of the last Ordinary Meeting, and of the Anniversary Meeting were read.

Charles Hood, Esq., F.R.A.S., of Earl Street, Blackfriars, and Francis Rawdon Moira Crozier, Captain R.N., were put to the ballot, and respectively elected Fellows.

A paper was read, entitled, "On a sudden rise and fall of the Sea in the Dock-yard Creek, Malta, on the 21st and 25th June, 1843." By S. Napier, Esq., Master-Attendant. Communicated by the Lords Commissioners of the Admiralty.

At 6 o'clock, A.M. on the 21st of June, the water was found to be 6 inches above the average height, and continued so till $6\frac{3}{4}$, when it rose to 18 inches, and in a few minutes sank to 3 feet 6 inches below the average; which oscillations continued till $8\frac{1}{2}$ A.M., when it resumed its usual level. On the 25th, a rise to the extent of 2 feet 6 inches above, followed by a fall of 3 feet below, the average, was observed; these alternations in height recurring four several times on that day. The author was unable to assign any particular cause for these extraordinary agitations of the sea.

December 14, 1843.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

A paper was read, entitled, "Researches into the Structure and Development of a newly-discovered Parasitic Animalcule of the Human Skin, the *Entozoon folliculorum*." By Erasmus Wilson, Esq., Lecturer on Anatomy and Physiology in the Middlesex Hospital. Communicated by R. B. Todd, M.D., F.R.S.

The animalcules which are the subject of this paper were discovered above a year ago by Dr. Simon, who published a description

of their structure in the number of Müller's 'Archiv,' &c. for June 1842. This description was found by Mr. Wilson, who devoted to the investigation six months of exclusive labour, to be, in many essential particulars, exceedingly inaccurate and erroneous. The present paper contains the principal results of the author's researches on these singular animalcules, which inhabit the sebaceous follicles of the human skin, and feed on the secretions that surround them. The author enters into minute anatomical details of the structure of the various organs, and more particularly of the apparatus by which the head is retracted within the thorax, of the eyes, of the ova, and the remarkable embryonic forms which are presented in the progress of development of the young animal. He applies to this animalcule the term *entozoon*, merely as signifying an inhabitant of the interior of the body, and until a better and more appropriate appellation shall have been assigned to it.

A paper was also in part read, entitled, "Miscellaneous Observations on Animal Heat." By John Davy, M.D., F.R.S.

The President announced from the Chair, that Mr. Charles Richard Weld had been appointed Assistant Secretary.

December 21, 1843.

JAMES WALKER, Esq., Vice-President, in the Chair.

The reading of Dr. Davy's paper, entitled, "Miscellaneous Observations on Animal Heat," was resumed and concluded.

The author, in the first section of this paper, after adverting to the commonly received opinion that all fishes are cold-blooded, and noticing an exception, as he believes, in the instance of certain fishes of the genus Thynnus and of the Scomber family, describes the observations which he made whilst at Constantinople, on the temperature of the *Pelamys Sarda*, when, in three different examples, he found its heat to exceed that of the surface-water by 7°, and of the deep water probably by 12°.

He adduces some observations and remarks on peculiarities in the blood of the same fish, of the sword-fish and of the common tunny, which he supposes may be connected with their temperature; and throws out the conjecture, that the constitution of their blood-globule, formed of a containing and contained part, namely the globule and its nucleus, may be to each other in the electrical relation of positive and negative, and may thereby act with greater energy in separating oxygen in respiration.

In the second section, on the temperature of man in advanced old age, he relates a number of observations made for the purpose of determining the actual heat of persons exceeding eighty years of age; the result of which, contrary to the commonly received opinion, is, that the temperature of old persons, as ascertained by a thermome-

ter placed under the tongue, is rather above than below that of persons of middle age; and this he thinks may be explained by the circumstance, that most of the food used by old persons is expended in administering to the function of respiration.

In the third section, on the influence of air of different temperatures on animal heat, after alluding to what he had witnessed of the rise and fall of the temperature of man on entering the tropics, and, within the tropics, on descending from a cool mountainous region to a low hot country, he adduces certain observations to show that in this country similar changes of temperature take place in a few hours in breathing the air of buildings artificially heated; and, in confirmation, he describes the results of many observations made on an individual in the very variable climate of Constantinople, where, between March and July, in 1841, the thermometer ranged from 31° to 94°.

In the fourth section, he describes the observations which he made to determine the effect of moderate exercise, such as that of walking, on the temperature of the body, tending to prove, that while it promotes the diffusion of temperature and produces its exaltation in the extremities, it augments very little, if at all, the heat of the central and deep-seated parts.

A paper was also in part read, entitled, "On the Thermal Changes accompanying Basic Substitutions." By Thomas Andrews, M.D., M.R.I.A., Professor of Chemistry in the Royal Belfast Institution. Communicated by M. Faraday, Esq., D.C.L., F.R.S., &c.

The author gives an account of a series of experiments which he made on the heat evolved during the mutual reaction of acids and bases upon one another, from which he draws the general conclusion that when the influence of all extraneous circumstances is eliminated from the result, the change of temperature is determined by the nature of the base, and not by the acid element of the combination. Hence he deduces the general law that, when one base displaces another from any of its neutral combinations with an acid, the heat evolved or abstracted is always the same, whatever the acid element may be, provided the bases are the same. The base employed in the first set of experiments for displacing others was the hydrate of potash in a state of dilute solution of known strength; this was rapidly mixed, in a suitable apparatus, with an equivalent solution of the salt to be decomposed; the change of temperature which resulted was accurately determined, and the due corrections for the influence of the vessels and the specific heats of the solutions and of the precipitates produced, were applied. The experimental results are stated in various tables, from which it appears that the changes of temperature, referred to 1000 parts of water, were, with salts of

Lime	from	− 0°·38	to	− 0°·38
Magnesia	„	− 0·10	„	− 0·15
Barytes	„	0·		0·
Strontia	„	0·		0·

Soda	from	+ 0°4	to	+ 0°14
Ammonia . . .	„	+ 0·72	„	+ 0·73
Manganese . . .	„	+ 1·04	„	+ 1·15
Proto-salts of iron .	„	+ 1·58	„	+ 1·63
Zinc	„	+ 1·71	„	+ 1·82
Mercury	„	+ 1·81	„	+ 1·89
Lead	„	+ 2·77	„	+ 2·90
Copper	„	+ 2·90	„	+ 3·18
Silver	„	+ 3·90	„	+ 3·94
Sesquisalts of iron .	„	+ 4·25	„	+ 4·28

The differences in the results of experiments with different acids, the author observes, are not greater than usually occur in chemical reactions, in consequence of the uncertainty that exists with regard to the accurate proportions of chemical equivalents. He points out various circumstances in experiments of this nature, which tend to affect the results and lead to inaccurate conclusions, if care be not taken to guard against these sources of error. One of the principal of these is the heat which is generally evolved by the separation of a base, or new compound, in a solid form: and the author discusses the influence of this change on the results deduced from his experiments. He considers that these experiments sufficiently establish the general principle announced in the beginning of his paper.

A supplementary note is added on the determination of the Specific Heat of Fluids.

The Society then adjourned over the Christmas recess, to meet again on the 11th of January, 1844.

January 11, 1844.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

"An Account of a slight Shock of an Earthquake felt in the Channel Islands." By J. Elliott Hoskins, M.D., F.R.S.: in a Letter to P. M. Roget, M.D., Sec. R.S., &c. Communicated by Dr. Roget.

The phenomena described in this letter occurred simultaneously in Jersey, Guernsey, Alderney, Serk, Herne, and Jethore. On Friday, the 22nd of December, at seven minutes before 4 P.M., a noise resembling a distant thunder-clap was heard; this was immediately followed by sounds as of a railroad carriage rumbling over an irregular metallic surface; it was accompanied by distinct undulatory motion. This again was succeeded by a shock; the whole lasting from 10 to 15 seconds. The barometer was uninfluenced, standing at 30·354: a light wind prevailed, varying from S.S.E. to S.S.W. During the whole of the month the air had been peculiarly still, and the barometer uniformly high; the maximum, up to the above date, having been 30·518, the minimum 30·042. The thermometer had ranged throughout the month, from 47° to 52° during the day, and from 45° to 49° during the night.

Hundreds of persons agree as to having experienced a distinct shock, their impressions varying according to the positions occupied by the observers. Those inhabiting the solid granite structures of the lower town conceived that heavy masses of furniture were overturned and moved in the apartments above or below them: they were not, however, so conscious of vibratory motion as those in the less substantial houses of the upper part of the town, or as those in the open air. In many houses, this vibratory motion was so violent as to cause much alarm, and was accompanied by crashing sounds, as though roofs and chimneys were falling; in some instances, chimney-pots were thrown down; suspended lamps were observed to wave; bells rang spontaneously; the vane of the town church waved, and one of its bells struck twice.

Persons in the open air were sensible of an undulatory motion, tending from the S.W., which occasioned unsteadiness of footing, and in some cases a transient feeling of nausea. A steam-engine in the Serk mines was remarked to suspend one out of its usual five strokes per minute; the engineer was alarmed lest this should be a precursor of bursting of the boiler. The massive granite works of St. Sampson's quay were so shaken, that glass vessels situated on various parts were thrown off. Two gentlemen engaged in Daguerreotype experiments on the ramparts of a fortification founded on a solid granite rock, felt the whole to vibrate. The crews of sailing-vessels beating up in the "roads," also felt the shock; those below rushing on deck under the impression that the vessels had struck on a rock.

The testimony of a great number of witnesses leaves no doubt as to the distinctness and strength of the shock. It was also felt, though in a slighter degree, in the neighbourhood of St. Malo, and near Brixham in Devonshire.

January 18, 1844.

SIR J. W. LUBBOCK, Bart., V.P., in the Chair.

"On a new Method of Analysis." By George Boole, Esq. Communicated by S. Hunter Christie, Esq., Sec. R.S., &c.

The purport of this paper is to exhibit a new form of analysis, and to found upon it a new theory of Linear Differential Equations, and of Generating Functions. The peculiarity in the form of the analysis consists in the linear differential equation, instead of being represented, as it has hitherto been, under the type

$$X_0 \frac{d^n u}{dx^n} + X_1 \frac{d^{n-1} u}{dx^{n-1}} \ldots\ldots + X_n u = X,$$

X_0, X_1, &c. being functions of the independent variable x, being exhibited in the form

$$f_0(D)\, u + f_1(D)\, \varepsilon^t u \ldots\ldots + f_t(D)\, \varepsilon^{rt} u = U;$$

in which $\varepsilon^t = x$, and $f_0(D)$, $f_1(D)$, &c. imply functional combina-

tions of the symbol D, which, for the sake of simplicity, is written in place of $\frac{d}{dv}$. This the author calls the exponential form of the equation; and he, in like manner, designates the analogous forms of partial and of simultaneous equations. What he conceives to be the great and peculiar advantage of the exponential form, both as respects the solution of linear differential equations, and the theory of generating functions, is that the necessary developments, transformations and reductions are immediately effected by theorems the expression of which is independent of the forms of the functions $f_0(D), f_1(D)$, &c. Accordingly it may be shown that various formulæ which have been given for the solution of linear differential equations, with those in which Laplace's theory of generating functions is comprised, interpreted into the language of the author, are but special cases of theorems dependent on the exponential form above stated, and which are susceptible of universal application.

The common method of effecting the integration of linear differential equations in series fails when the equation determining the lowest index of the development has equal or imaginary roots. In a particular class of such equations of the second order, Euler has shown that $\log. x$ is involved in the expression of the complete integral: but this appears to be merely a successful assumption; and the rule of integration demonstrated in the present paper admits of no such cases of exception whatever.

The finite solution of linear differential equations may be attempted by resolution of the proposed equation into a system of equations of an inferior order. This method applied to the linear equation under its usual forms leads to the well-known solution of equations with constant coefficients: and when applied to the same equation under the exponential form, it gives a result embracing the solution not only of equations with constant coefficients, but also of a large class of equations with variable coefficients.

The author treats,—1st, of the solution of linear differential equations, total and partial, in series; 2ndly, of their finite integration; 3rdly, of the theory of series, or inverse method of development; 4thly, of linear equations of differences, total and partial, of certain miscellaneous applications, chiefly in the field of definite integrals, single and multiple.

January 25, 1844.

SIR J. W. LUBBOCK, Bart., V.P., in the Chair.

"A Description of an extensive Series of the Water Battery; with an account of some Experiments made in order to test the relation of electrical and chemical action which takes place before and after completion of the Voltaic Circuit." By John P. Gassiot, Esq., F.R.S.

In a former paper, which was printed in the Philosophical Transactions for 1839, the author described a series of experiments made

with some powerful voltaic batteries, for the purpose of determining the possibility of obtaining a spark before the completion of the circuit. This anticipated effect was not, however, produced. A short time after, Mr. Cross stated that he had succeeded in procuring a spark from a battery of 1626 cells of copper and zinc, acted upon by river water. The author, pursuing his researches, constructed a battery consisting of 3520 pairs of copper and zinc cylinders, each pair being placed in a separate glass vessel, well covered with a coating of lac varnish, and insulated by being placed on slips of glass covered on both sides with a thick coating of lac. The cells were placed on 44 separate oaken boards, also covered with lac varnish, each board carrying 80 cells, and sliding into a wooden frame, where they are further insulated by resting on pieces of thick plate-glass, similarly varnished.

In describing the effects which this apparatus has produced, the author endeavours to draw a distinction between the static and the dynamic effects of the developed electricity, and treats of each separately. The conclusions to which he is led from the series of experiments narrated in this paper, are the following:—

1. The elements constituting the voltaic battery assume polar tension before the circuit is completed, even in a single cell; this polar state being shown to exist by the action exerted on the electroscope being different at each polar extremity of the battery.

2. The tension, so produced, when exalted by a succession of series, is such, that a succession of sparks passes between the polar extremities of the battery before their actual contact.

3. The static effects precede, and are independent of the completion of the voltaic circuit, as well as of any perceptible development of chemical or dynamic action.

4. When the current is established, either by actual contact of the extremities, or merely by their approximation, so as to admit of a succession of sparks, its dynamic effects on the galvanometer are the same in both cases; each spark producing a constant deflection of the needle. It is hence inferred that the current, even when the circuit is closed, may be regarded as a series of discharges of electricity of tension, succeeding each other with infinite rapidity.

5. In a battery, of which the chemical elements have but a feeble mutual affinity, as is the case with the water battery, the tension rises very slowly.

6. In order to produce static effects in the voltaic battery, it is an indispensable requisite that the elements be such as are capable of combining by their chemical affinities: and the higher those affinities are exalted, the smaller is the number of parts composing the series requisite to exhibit the effects of tension. The static effects elicited from a voltaic series, afford, therefore, direct evidence of the first step towards chemical combination, or dynamic action.

The author observes, in conclusion, that the chemical effects, when obtained in most of the experiments he has described in this paper, are very feeble; but are precisely the same in character as those exhibited by the more powerful voltaic combinations; and he thinks

it may fairly be concluded that the rationale of each is the same, and that they differ only in the amount of action.

February 15, 1844.

SIR J. W. LUBBOCK, Bart., V.P., in the Chair.

"Some further Observations and Experiments illustrative of the Cause of the Ascent and continued Motion of the Sap," in continuation of a Paper presented to the Royal Society in November 1842. By G. Rainey, Esq. Communicated by P. M. Roget, M.D., Sec. R.S.

The author here gives an account of some experiments which he has lately made, tending, in his opinion, to corroborate the opinions he advanced in his former paper; namely, that the ascending sap is situated in the intercellular and intervascular spaces of the plant, and that its passage into the cells is effected by the action of endosmose, which the intervening membranes, whether living, or deprived of vitality, exert upon that fluid. He found that portions of many plants, such as *Anthriscus vulgaris*, and the *Lapsana communis*, absorb a much larger quantity of fluid when they are immersed in pure water, than when similarly immersed in a solution of gum-arabic; and that, in the latter case, the remaining portion of the solution is of the same specific gravity as before any part has been absorbed by the plant. By a similar process, the author conceives, the fluid which is derived from the earth, and has passed into the intercellular spaces of the cotyledons, are imbibed by its cells by endosmose; while at the same time a fluid containing sugar is passing, by exosmose, out of these cells into the intercellular and intervascular tissue, and thence into the corresponding tissue of the peduncle and young stem; it there meets with, and is diluted by the water ascending in the same tissue from the roots, and the mixture is afterwards distributed over every part of the plant.

February 22, 1844.

SIR J. W. LUBBOCK, Bart., V.P., in the Chair.

"On the Temperature of the Springs, Wells and Rivers of India and Egypt, and of the Sea and Table Lands within the Tropics; with a few Remarks on M. Boussingault's mode of ascertaining the mean temperature of Equinoctial Regions." By Lieut. Newbold, of the Madras Army, F.R.S.

The author adverts to the deficiency of information which has hitherto existed as to the temperature and chemical composition of the springs and rivers both of India and of Egypt; and also as to their geographical and geological relations. He gives, in the present paper, the details of a great number of observations which he has made on these subjects, and which he thinks may prove a useful contribution to Indian hydrography, as well as afford more exact data for philosophical inquiry. The observations extend, at irregular in-

tervals, from Alexandria to Malacca, or from 31° 13′ of northern latitude to within 2° 14′ of the Equator, and between the meridians of 27° and 103° of east longitude. In the columns of the register, the date of the observation, the latitude, longitude, approximate height above the sea, nature of the surrounding geological formation, depth to the surface of the water, depth of the water itself, temperature of the air, and approximate annual mean of the climate in which the wells, &c. occur, are, as far as practicable, specified. A column of remarks is added, containing observations on the chemical nature of the water, and on the size of the wells and springs, and the result obtained by other observers.

It was found, in general, that in low latitudes the temperature of the deepest wells and springs is a little higher than the mean temperature of the air; although there occur a few exceptions, especially in the neighbourhood of a high range of hills, whence there probably arise cold springs, having their source at an elevation considerably above that of the plain where the water makes its appearance. Springs which are strongly saline and sulphureous, have, on the average, a higher temperature than those of pure water. Both saline and cold springs are found occurring within a few feet from thermal and freshwater springs: a fact which the author is disposed to ascribe to their rising through different seams of the subjacent strata, often much inclined; and to the different depths and heights, above and below the crust of the earth, from which the supply of water is derived. Wells, and particularly those having a small surface, which are much used for purposes of irrigation, thereby acquire an artificial increase of temperature. The temperature of shallow exposed wells, springs and rivers, especially those which have sandy beds, is subject to diurnal fluctuation from the more powerful influence of the atmosphere: and the surface water of deep wells partakes of these vicissitudes to a depth varying according to the transparency of the water, the extent of surface, degree of exposure and clearness of the sky. In muddy water, the surface is heated to a greater extent; but at the depth of a foot or two, it is less affected by the heat of the solar rays than clear water.

With regard to Boussingault's proposal of an expeditious mode of ascertaining the approximate mean temperature of equinoctial regions, which consists in sinking a thermometer in the soil, perforated to the depth of about a foot beneath the surface, in a situation sheltered from the direct rays of the sun, from nocturnal radiation, and from the infiltration of water, the author found that the application of this method gave the following results, namely, that the soil at the depth of a foot is subject to an annual, and, in light soils, to a diurnal variation, regulated in its amount by the relative intensity of the solar rays, and the quantity of radiation, depending, of course, on the state of the atmosphere, and the degree of shelter afforded to the surface.

February 29, 1844.

SIR J. W. LUBBOCK, Bart., V.P., in the Chair.

"On the Electrolysis of Secondary Compounds." By John Frederic Daniell, Esq., D.C.L., For. Sec. R.S., and Professor of Chemistry in King's College, London; and W. A. Miller, M.D., Demonstrator of Chemistry in the same College.

The authors of this paper have further prosecuted the inquiry into the phenomena of electrolysis, commencing from the point to which it had been carried by Professor Daniell in his papers published in the Philosophical Transactions for 1839 and 1840. He had there shown, that in the electrolysis of neutral saline solutions, if the metal is one of those which do not decompose water at ordinary temperatures, it is precipitated in the metallic state at the platinode; but if it belong to the class of those which, at ordinary temperatures, do decompose water, then an equivalent of the oxide is liberated at the platinode, while an equivalent of hydrogen makes its escape in the gaseous form from the same electrode; the acid, in both cases, being, at the same time, liberated at the zincode, accompanied by an equivalent proportion of oxygen. On comparing these results with those of an independent voltameter included in the same circuit, it was found that a certain definite proportion of the force which resolves a single equivalent of a *simple* electrolyte into its anion and cation, produces the resolution of a full equivalent of a *complex* electrolyte into a simple metallic cation and a compound anion. When ammoniacal salts in solution were thus decomposed, ammonia, with an equivalent of hydrogen, was liberated at the platinode; while the acid, with an equivalent of oxygen, was evolved, as before, at the zincode.

Experimental evidence was thus obtained in support of two important theories; namely, the ammonium theory advanced by Berzelius; and the binary theory of salts propounded by Davy; in which latter theory, all saline compounds are regarded as being formed on the type of the salts of the hydro-acids. This binary composition of salts is, in the present paper, proved to exist, not only when the salts, previously held in solution by water, are decomposed by the voltaic current, but also when the fused anhydrous salt is electrolysed: for example, metallic silver in crystals is deposited upon the platinode, when fused nitrate of silver is included in the circuit.

On examining, by the current, the monobasic, dibasic, and tribasic phosphates, the authors found that there were three distinct modifications of the acid transferred. From the monobasic phosphates there was obtained the metaphosphoric acid; from the dibasic salts, pyrophosphoric acid; and from the tribasic salts, the ordinary phosphoric acid was set free at the zincode. The acids were transferred into weak alkaline solutions and recognised by their appropriate tests. The view entertained by Professor Graham of the composition of these salts is therefore completely confirmed.

On the other hand, the authors found, by similar experiments made with the yellow and the red prussiates of potash, that only one com-

pound of cyanogen and iron, or ferrocyanogen as it exists in the yellow salt, is evolved at the zincode; and they not only converted the yellow into the red salt by electrolytic action, but, conversely, reproduced the yellow from the red.

In pursuing their researches on double salts, a new order of facts was brought to light, which clearly proved that although the two ions of the electrolyte are always *evolved* in equivalent proportions, yet that they are not *transferred* in equivalent proportions to the respective electrodes; that some bases, such as copper, zinc, iron and alumina, do not travel at all towards the platinode; that some, as magnesium, do so in small proportion only; and that others, as barium and potassium, are transferred in greater abundance; those whose oxides are most soluble appearing to travel most easily. On the other hand, the acids, whether forming soluble hydrates or not, seem all to travel towards the zincode, in proportions dependent principally on the nature of the base with which they are united.

The curious phenomena which have thus been brought to light, concur in establishing the general fact, that the disengagement of the cation and anion of an electrolyte in equivalent proportion is not always affected, as is commonly represented, by their simultaneous transfer in opposite directions to their respective electrodes, in the exact proportion of half an equivalent of each; but that it is sometimes brought about by the transfer of a whole equivalent of the anion to the zincode, whereby a whole equivalent of the cation is left uncombined at the platinode, or by the transfer of unequivalent portions of each in opposite directions, making together a whole equivalent of matter transferred either to one electrode or to the other; or, in other words, by the transfer of a quantity of matter capable of exercising one equivalent of chemical force: so that when the anion transferred to the zincode exceeds half an equivalent, the cation transferred to the platinode is, in an equal proportion, less than half an equivalent, and *vice versâ*; the anion and cation set free being always in equivalent proportions. In no case, however, has there been observed the transfer of a whole equivalent of the cation to the exclusion of the anion.

These facts, the authors conceive, are irreconcileable with any of the molecular hypotheses which have been hitherto imagined to explain the phenomena of electrolysis.

March 21, 1844.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

"A description of certain Belemnites, preserved, with a great proportion of their soft parts, in the Oxford clay at Christian Malford, Wilts." By Richard Owen, Esq., F.R.S., &c., Hunterian Professor of Anatomy and Physiology in the Royal College of Surgeons.

The author describes, in the present paper, specimens of Belemnite, discovered in the Oxford-clay at Christian Malford, Wilts, and

which are remarkable for the preservation of many of the soft parts of the animal. After alluding to the various opinions promulgated by different authors respecting the nature and affinities of this extinct animal, he adverts more especially to the discovery of the ink-bag of the Belemnite, which was published in the Zoological Transactions, vol. ii., and in the Cyclopædia of Anatomy and Physiology (Art. Cephalopoda). This discovery led him, on the strength of deductions from the physiological relations of this organ, to remove the Belemnite from the *Polythalamacea* of De Blainville, and place it in the higher order of the naked Cephalopods.

The structure of the shell is next discussed, and the spathose dart, or guard, is proved to be the result of original organization, both by its microscopic structure and by the fact that the chambers of the phragmocone have not been infiltrated by mineral substance in any of the specimens described: the name *phragmocone* being applied to the chambered and siphonated conical division of the compound shell of the Belemnite; and the term *alveolus* being restricted, in the present paper, to the socket or cavity at the base of the guard, in which the phragmocone is lodged. A detailed description is given of the sheath of the phragmocone and of the structure of the chambers. The state of preservation of the present specimens has enabled the author to describe the form and extent of the mantle—its continuation over the exterior of the shell, and the arrangement of its muscular fibres. The animal is provided with two lateral fins of a semi-oval figure, which are attached to the middle of the mantle, in advance of the spathose dart.

The muscular fibres of the fins, the infundibulum and its muscles are next described; and also the head, the eyes, which are large and sessile, and the cephalic arms, which are eight in number; together with traces of two slender superadded tentacula. The ordinary arms are furnished with a double alternate row of sharp horny hooks, as in some existing species of *Onychoteuthis*, but the arms are relatively longer. Their muscular structure is traced in the fossil specimens, and compared with that in the recent Decapoda. The ultimate, or primitive fibres of the muscles of the Belemnite agree in size with those in the *Onychoteuthis*; but the character of the transverse striæ, which is feebly developed in the primitive muscular fibre of the Cephalopods, is not preserved in the fossil. Of the interior organs of the Belemnite, besides the ink-bag and duct, which had been before discovered by Drs. Buckland and Agassiz, the remains of the horny lining of the gizzard are preserved in the present fossils.

Thus the deduction that the higher, or dibranchiate type of Cephalopodal organization is necessarily associated with the presence of the atramental apparatus, is established by the demonstration, in these fossil Belemnites, of a fleshy mantle, inclosing the shell, and provided with a pair of muscular fins, of large and sessile eyes, and of few, but large and complex cephalic arms.

The author concludes by pointing out the more immediate affinities of the Belemnites, and showing that it combines characteristics which are now divided amongst distinct genera: as, for example,

first, a complex internal shell, divisible into the same principal parts as that of the *Sepia*, but one of which has, secondly, the same essential chambered structure as the shell of the *Spirula*; thirdly, uncinated cephalic arms, as in the *Onychoteuthis*; and lastly, an advanced position of rounded fins, as in the *Spirula* and *Rossia*.

The paper is illustrated by drawings of the specimens described, with microscopic views of the shell and muscular tissue, and a restoration of the Belemnite according to the data afforded by the present fossils.

April 18, 1844.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

1. Note in addition to Mr. Gassiot's paper on the "Water Battery." The author here describes an instrument which he has recently constructed, and by means of which he is enabled with great facility, and without the aid of Zamboni's pile, to test the tension in a single series of the voltaic battery.

2. "On the production of Ozone by Chemical Means." By Professor Shoenbein, in a letter to Michael Faraday, Esq., D.C.L., F.R.S. Communicated by Dr. Faraday.

The author conceives that of the two gaseous principles which are simultaneously produced during the slow action of phosphorus upon atmospheric air, and which have opposite voltaic characters, that which exerts electro-positive properties is composed of vaporized phosphorus, conjoined with particles of phosphatic acid; and the other, which is electro-negative, is identical with *ozone*, or the odoriferous principle which is disengaged at the positive electrode during the electrolysis of water. His opinion is founded on the odour of the one not being distinguishable from that of the other.

3. "Contributions to Terrestrial Magnetism." No. VI. By Lieut.-Colonel Sabine, R.A., F.R.S.

This portion of the series consists of observations made on board Her Majesty's ships Erebus and Terror, from June 1841 to August 1842, in the Antarctic Expedition under the command of Captain Sir James Clark Ross, R.N., F.R.S. It comprises the result of the operations conducted during the second year of the expedition, when it proceeded early in July 1841, from Hobarton to Sydney, and thence to the Bay of Islands in New Zealand, remaining there till November, and reaching, in February 1842, in latitude 78°, the icy barrier which had stopped their progress in the preceding year. Quitting the antarctic circle in March, and keeping nearly in the 60th parallel, they crossed the whole breadth of the Southern Pacific Ocean to the Falkland Islands, where they arrived in April 1842.

On a general review of the magnetic declination in the southern

nemisphere, the phenomena are found to present the same obvious and decided features of a duplicate system as those of the northern. Particular attention is given to those lines traversed by the ship's course where the needle attains its maximum declination, whether easterly or westerly, as affording valuable data for the estimation of secular variations. The results obtained by the present expedition confirm the conclusion deducible from those of previous navigators; namely, that the spaces in the Southern Pacific, distinguished by certain magnetic characters, undergo a movement of translation, of which the general direction is from east to west; a direction which is the opposite to that in which a similar change takes place in the corresponding regions of the northern hemisphere; namely, in the Siberian quarter, where the secular movement is from west to east.

April 25, 1844.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

1. "On the production of Ozone by Chemical Means." By C. F. Shoenbein, Professor of Chemistry at Basle, in a second letter to Michael Faraday, Esq., D.C.L., F.R.S. Communicated by Dr. Faraday.

The author adduces further evidence in support of the opinions he advanced in his former communication relative to the identity of the odoriferous principles which are disengaged during electric discharges in common air, during the electrolysis of water, and during the slow action of phosphorus upon atmospheric air. This principle, termed *Ozone*, he regards as being a simple body, and a constituent of azote, which he believes to be a compound of hydrogen and ozone; and he explains the disengagement of this latter element, which he considers as analogous in its chemical character to chlorine, by the partial decomposition of azote, in consequence of its hydrogen combining with oxygen, in the several processes above-mentioned during which ozone makes its appearance.

2. "On the existence of Phosphoric Acid in Rocks of igneous origin." By George Fownes, Esq., Ph. D., Chemical Lecturer in the Middlesex Hospital Medical School. Communicated by Thomas Graham, Esq., F.R.S.

The author has, by careful analysis, ascertained the presence of phosphoric acid in various rocks of igneous origin. Those which he examined were principally the following; namely, 1. The fine white porcelain clay of Dartmoor, resulting from the disintegration of the felspar of the granite of that district. 2. Dark grey vesicular lava from the Rhine, used at Cologne as a building-stone. 3. White trachyte from the Drachenfels, near Bonn. 4. Dark red, spongy, scoriaceous lava from Vesuvius. 5. Compact, dark green basalt, or toadstone from Cavedale, Derbyshire. 6. Dark blackish-green basalt from the neighbourhood of Dudley, termed

Rowley-ragg. 7. Ancient porphyritic lava, containing numerous crystals of hornblende, from Vesuvius. 8. A specimen of tufa, or volcanic mud, also from Vesuvius.

The author infers from his analysis that phosphoric acid is a very usual component part of volcanic rocks, and is a principal source of the remarkable fertility possessed by soils derived from their disintegration.

May 2, 1844.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

1. "Ranges of the Barometer and Sympiesometer on board H.M.S. 'Alfred,' in the River Plate, between the 1st of July and the 31st of December, 1843." Communicated by Captain Beaufort, R.N., F.R.S.

This paper is a register of the results of daily observations of the heights of the barometer, sympiesometer and thermometer, the direction of the wind, and state of the weather during the above period.

2. "Remarks on the amalgamation of Silver Ores in Mexico; with an account of some new combinations of Copper, Oxygen and Chlorine." By John Christian Bowring, Esq. Communicated by S. Hunter Christie, Esq., Sec. R.S.

The process employed in Mexico for amalgamating ores containing sulphurets of silver, and which consists in adding to them a solution of bichloride of copper with chloride of sodium, is explained by Sonneschmidt, Humboldt, and Boussingault, on the supposition that a chloride of silver is formed at the same time that the sulphur combines with the copper. The author calls in question the truth of this theory, and proposes certain modifications of the process by the employment of a combination of deutoxide of copper with the bichloride, until an oxy-chloride is formed, and then adding finely precipitated copper, by which a salt of a brick-red colour is obtained, insoluble in water, and at a temperature of 200° Fahr. speedily reducing sulphuret of silver to the metallic state.

3. "Experimental evidence in support of the secretion of Carbon by animals." By Robert Rigg, Esq., F.R.S.

The author finds that the mean of the results of different experimentalists as to the quantity of carbon excreted by respiration from adults, during twenty-four hours, is 5963 grains; whereas the weight of the carbon contained in the whole of the food, both solid and liquid, received into the body during the same period, as ascertained by the analysis of each article of diet, made by the author, falls very short of that quantity; varying in different cases from 3002 to 4800 grains. The same inference is drawn from experiments made on a mouse, weighing 181 grains, confined in a wire trap for twenty-eight days; during which time it consumed food containing 544·5 grains of carbon, and gave out, in the respired air,

741·2 grains of carbon, being 196·7 grains more than it had received; and it had also gained in absolute weight 27 grains. The conclusion which the author deduces from these experiments is, that carbon is actually formed or secreted by animals.

May 9, 1844.

JAMES WALKER, Esq., V.P., in the Chair.

"On the Hyssop of Scripture." By J. F. Royle, M.D., F.R.S., &c.

Many attempts have at different times been made, by various authors, to identify the plant which, in our authorized version of the Scriptures, is translated *Hyssop*. The author enters at large into the history of the speculations of former writers on this subject; and after an elaborate investigation, is led to the conclusion that this plant is the *Capparis spinosa* of Linnæus, or Caper plant, a shrub abundantly met with in the south of Europe, where it appears to be indigenous, and also generally on the islands and coasts of the Mediterranean, as well as in Lower Egypt and in Syria.

May 16, 1844.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

1. "On the Measurement of Distances by the Telescope." By Edmund Bowman, Esq., C.E. Communicated by S. Hunter Christie, Esq., Sec. R.S.

The method proposed by the author for determining distances by means of a telescope, consists in placing, at the spot of which the distance is required, a graduated staff, and observing the number of its divisions comprehended in the field of the telescope, or included between fixed points in a diaphragm placed in the focus of the eye-glass. He finds that the number of these divisions, apparent in the field of view, are directly as the distance of the staff, plus a certain constant, which depends on the construction of the instrument. The author investigates the value of this constant, and illustrates the practical applications of his method, which he thinks might be employed with great advantage in surveying, when, from irregularities of ground or difficulties of access, the direct measurement by the chain would be inconvenient or impossible.

2. "An Account of some Experiments exhibiting new instances of the Absorbing Power of Streams; with a few remarks on the Pulsation of Jets." By Mr. G. Robinson. Communicated by W. Bowman, Esq., F.R.S.

The experiments of which an account is given in this paper

illustrate the absorbing power of a stream of fluid, whether issuing from the open orifice of a reservoir, or flowing through rigid tubes. The effects of this power are seen in the position of the fluid contained in a vertical tube open at both ends, placed within the reservoir, and of which one end is brought within the influence of the effluent stream; and also, when one end of a bent tube is brought into the stream issuing from the open orifice of a reservoir, while the other end is immersed in a coloured fluid. The author accounts for the intermitting or pulsatory character of the jet issuing from an open horizontal pipe, having a small hole on the upper side, by the introduction of air, which, accumulating from time to time, forms a bubble, which when it has attained a certain size, occasions an obstruction to the free passage of the liquid, until the obstacle is overcome by increased pressure from behind, and the jet then resumes its former velocity. These changes occurring periodically, give rise to the appearance of pulsation which is observed in these circumstances.

May 23, 1844.

ROBERT BROWN, Esq., V.P., in the Chair.

1. "Meteorological Register kept at the Master Attendant's Office, Trincomalee, between the 1st of September, 1843, and the 29th of February, 1844." By Joseph Higgs, Master Attendant. Communicated by the Lords Commissioners of the Admiralty.

2. "On the supposed Properties of the Electric and Magnetic Fluids." By W. F. Stevenson, Esq., F.R.S.

The author is of opinion that electricity is a single undecomposable fluid, and that the distinction usually made into vitreous and resinous, or positive and negative electricities, is derived altogether from the direction of its motion and the circumstances under which it is presented; and, according as it is found on a conducting or non-conducting body, it is positive in the former case and negative in the latter. The quality of the electricity is, according to the author, modified by the form of the conducting body, which, when globular, opposes its escape; but, when pointed, facilitates its passage in a current. He considers the magnetic fluid as obeying the same law as the electric fluid, that is, moving in a current, which when aided, and not interrupted, will always be found positive, or having a north pole, at that end of the conductor or magnet where the fluid is escaping; and negative, or with a southern polarity, at the opposite extremity.

3. "De l'Education des Animaux; faisant suite à l'ouvrage publié en 1842, et qui a pour titre Essai sur l'Education des Animaux." Par St. Léonard de Lille, Membre de diverses Sociétés scientifiques, et de l'Athénée des Arts de Paris, et son Employé des Finances. Première partie de l'Institut et de l'Intelligence, Education et Civilisation. Communicated by J. F. Daniell, Esq., For. Sec. R.S.

The present paper purports to be the sequel of a work, already published by the author, on the subject of the education of animals. It is the first part only of the paper which is here presented, and contains preliminary observations on the nature of the inquiries which the author proposes to enter into in the subsequent parts. It is divided into three chapters; the first comprising some general remarks on the objects to be attained in the education of animals, and some criticisms on the opinions of preceding writers relating to the subject; the second treating principally of Instinct and its characteristic features, as contrasted with Intelligence and Reason; and the third entering into various metaphysical disquisitions on the nature and peculiar sphere of action of the different intellectual faculties, both those which are common to man and the lower animals, and those which are peculiar to the former.

June 13, 1844.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

1. "On the Action of the Sun's Rays on Lithic Acid." By John Davy, M.D., F.R.S. Lond. and Edinb.

The author, after adverting to the composition of guano, and remarking that its nitrogenous part differs from the urine of the sea-fowl, from which it is derived, chiefly in containing little or no lithate of ammonia, but a large proportion of the oxalate, describes an experiment made for the purpose of determining whether the oxalic acid existing in guano may not be formed from the lithic acid of the urine, in consequence of the operation of the sun's rays. The result of a comparative trial made with the urine of the white-headed Sea-Eagle, in one instance kept in darkness, in the other exposed to bright sunshine for many successive days, afforded an answer in the affirmative. Whilst the urine of the Sea-Eagle, consisting chiefly of lithate of ammonia, kept in the dark, underwent no change, that exposed to light was materially changed, most of the lithate of ammonia had disappeared, its place was supplied by oxalate of ammonia, the peculiar odour of guano was acquired, and in part its brownish hue.

From considering the composition of the lithic and oxalic acids, the author infers, that in the conversion of the one into the other, oxygen is absorbed; and, in confirmation, he mentions that although no change takes place when moist lithate of ammonia is exposed alone to a temperature of about 212°, it is otherwise if so treated when mixed with black oxide of manganese, in which case oxalate of ammonia is formed, and also some brown colouring matter, not unlike that of guano; and this colouring matter, he supposes, may appropriate to itself the excess of carbon and hydrogen, that is, such proportions of these substances in the lithic acid as are more than those required to form oxalic acid and ammonia.

Having always found in the South American guano more distinct traces of lithate of ammonia than in the African, he inquires whether the difference may not be owing to different states of atmosphere in the two regions;—in the one, the clouded state of the air impeding the sun's rays; in the other, the usually unclouded state interposing no obstacle to their full effect. He inquires too, whether the circumstance of the comparatively rapid conversion of lithic acid into the oxalic under the influence of light, as witnessed in the experiment detailed, may not account for even recently formed guano being destitute of lithate of ammonia; and he mentions an example in point, namely, a specimen he had received from the island of Ichabor being found with a large quantity of oxalate of ammonia, to contain no lithate of ammonia,—a specimen described as "having been scraped off a rock, where it was in a thin layer, and much exposed to the sun."

2. "An Account of the Newtonian Dial presented to the Royal Society, in a letter to the President." By the Rev. Charles Turnor, F.R.S.

The dial here described was taken down in the early part of the present year from the south wall of the Manor-house of Woolsthorpe, a hamlet to Colsterworth in the county of Lincoln, the birth-place of Newton. It was marked on a large stone at the angle of the building, and about six feet from the ground. The name of NEWTON, with the exception of the first two letters, which have been obliterated, are inscribed under the dial in wide and capital letters. The gnomon has disappeared many years ago.

3. "On the Non-coincidence of the Focus of the Photogenic Rays with that of the Visual Rays of the Solar Spectrum." By M. A. Claudet. Communicated by S. Hunter Christie, Esq., Sec. R.S., &c.

After detailing the difficulties he had met with in obtaining perfect pictures when a lens, accurately corrected for spherical and chromatic aberration, was employed in the Daguerreotype process, the author states that in order to obtain a clear and well-defined image of any object on the Daguerreotype plate, he generally found it necessary to adjust the focus on the ground glass by another object brought considerably nearer to the camera than the object whose picture was required. When this adjustment is made, he proceeds to apply the principle practically to the taking of portraits. He finds that in achromatic object-glasses the focus of photogenic action is not coincident with the visual focus; and the distance between these two foci varies according to the nature of the combination of the glasses, to their different dispersive powers, and to the degree of intensity of the light. By attention to these circumstances in accurately adjusting the Daguerreotype plate to the situation of the focus of the photogenic rays, the author has succeeded in obtaining the most perfect delineations of objects.

4. "Observations on some of the Nebulæ." By the Earl of Rosse, FR.S.

The nebulæ, of which an account is given in this paper, were observed with the speculum of three feet aperture described in the Philosophical Transactions for 1840: and the object of the observations was rather to test its powers and to decide the merits of progressive experiments than to seek for astronomical results. Sketches are given of the actual appearance of five of the nebulæ observed, namely those numbered 88, 81, 26, 29 and 47 in Sir John Herschel's catalogue. The author observes, in conclusion, that all that he has seen confirms the accuracy of Sir John Herschel's judgment in selecting the nebulæ which he places in the class designated as resolvable; and that every increase of instrumental power still continues to add to the number of the clusters at the expense of the nebulæ, properly so called. It would still, however, be unsafe, he further remarks, to conclude, that such will always be the case, and thence to draw the obvious inference that all nebulosity is but the glare of stars too remote to be separated by the utmost power of our instruments.

June 20, 1844.

JAMES WALKER, Esq., V.P., in the Chair.

1. "On the Structure of the Ultimate Fibril of the Muscle of Animal Life." By Erasmus Wilson, Esq., Lecturer on Anatomy and Physiology in the Middlesex Hospital; in a Letter addressed to Peter Mark Roget, M.D., Sec. R.S. Communicated by Dr. Roget.

By resorting to peculiar methods of manipulation, and employing a microscope of more than ordinary power, the author, with the assistance of Mr. Lealand, has succeeded in discovering the real structure of the ultimate muscular fibril, in a specimen taken from the arm of a strong healthy man immediately after its amputation. He finds each fibril to be composed of minute cells, disposed in a linear series, flattened at their surfaces of apposition, and so compressed in the longitudinal direction as to leave no marginal indentation on the surface; thus constituting a uniform cylinder, divided into minute subdivisions by transverse septa, which are formed by the adherent surfaces of contiguous cells. The diameter of the fibril, in the state of relaxation, is the 20,000th part of an inch. The cells are filled with a transparent substance, to which the author gives the name of *Myoline*, and which differs in its refractive density in different cells. In four consecutive cells the myoline is of greater density than in the four succeeding cells, and this alternation is repeated throughout the whole course of the fibril. In consequence of all the fibrils composing the ultimate fasciculus having the same structure, and the cells, which are in lateral juxtaposition, containing myoline of the same density, they act similarly on light, and the whole presents, to the eye of the microscopic observer, a succession of striæ or bands, dark and luminous alternately, and transverse to the direction of the fasciculus; an appearance

which has been noticed by preceding observers, but of which the cause had not hitherto been ascertained. A dark stria may occasionally appear as a luminous one, and *vice versâ*, when viewed by light transmitted at different degrees of obliquity.

The structure here described, the author remarks, reduces the muscular fibre to the simple type of organization exhibited in the combination of a series of cells, associating it with other tissues of cell formation, and will probably, he thinks, open new sources of explanation of the immediate agency of muscular action, a power hitherto involved in the deepest mystery.

2. "On the Comparative Anatomy of the Thyroid Gland." By John Simon, Esq., Assistant Surgeon to King's College Hospital, and Demonstrator of Anatomy in King's College. Communicated by Joseph Henry Green, Esq., F.R.S.

The author, considering that the careful dissections of Meckel and Cuvier have fully established the universal existence of a thyroid gland in the whole of the class Mammalia, proceeds to consider the comparative anatomy of this organ in the remaining classes of vertebrated animals. His dissections of birds have included all the orders, and, in most instances, several families from each: he has never failed to find in them a thyroid gland, and, with the aid of the microscope, to recognise its peculiar structure; he presumes, therefore, that it is universally present in that class of animals. He has also detected the presence of this organ in reptiles of every order; although generally either wholly overlooked by anatomists, or mistaken for the thymus. Descriptions are here given of its appearance, position and structure in different families of Chelonia, Sauria, Ophidia and Batrachia. In the class of Fishes, it is by no means universally or even generally present. The author has found it in the carp, anableps, pike, exocetus, cod, haddock, whiting, eel, sturgeon, callorhynchus, shark and skate, and perhaps in the lamprey. On the other hand, it appears to be absent in the perch, mullet, gurnard, mackerel, tench, salmon, trout, herring, plaice, halibut, turbot, sole, cyclopterus, gymnotus and balistes.

The general conclusion which the author deduces from his researches is, that the distribution of the thyroid gland is regulated by a simple and uniform law; being dependent on the existence or non-existence of another organ with which its presence alternates, and which, in many fishes, assumes the form of a minute supplementary gill, the vessels of which communicate, on the one hand, with the systemic veins about the base of the cranium, and on the other, by a single long trunk with the first branchial vein.

Although the thyroid gland occupies various situations in different animals, it always maintains an intimate relation with the vascular supply of the brain, and is always so nourished as to be capable of a greater or less nutrition according to the activity or repose of that nervous centre.

3. "On the Resolution of Numerical Equations." By Joseph Agar,

M.D., Fellow of the Royal College of Physicians. Communicated by John Ayrton Paris, M.D., President of the College.

The object of this paper, which is purely analytical, is to explain a method of resolving numerical equations with real coefficients, which recommends itself by its simplicity and generality.

4. "On the Reproduction of lost parts in Myriapoda and Insecta." By George Newport, Esq., F.R.C.S., President of the Entomological Society of London, and Corresponding Member of the Philomathic Society of Paris. Communicated by P. M. Roget, M.D., Sec. R.S.

It has long been known that the limbs of Crustacea and Arachnida, accidentally lost or designedly removed, are, in course of time, replaced by the growth of new limbs; and the same power of reproduction has been stated to have been observed in the Phasmæ, insects which undergo neither metamorphosis nor any change of habits. But whether such a power exists in those insects, such as the Lepidoptera, which undergo a complete metamorphosis, changing not only their form, but also their food and mode of life, in passing from the larva to the adult state, has been considered as very doubtful. The instances in which the reproduction of lost parts appeared to have occurred in some of the Myriapoda, were attributed to imperfect or arrested development. With a view to determine these unsettled points, the author commenced, in the summer of 1841 and 1842, a series of direct experiments on this subject in the Myriapoda; and in the present summer he has extended them to the Lepidoptera. The results of his labours are given in the present memoir.

In some specimens of Iulus, from which he had removed the antennæ and some of the legs, the lost organs were found to be completely reproduced after the next change of integument; differing from the original organs only in their smaller size, and the incomplete development of some of their minuter parts. The same results followed from similar experiments made on the Lithobris during the earlier periods of its growth. One individual of this genus, which had already acquired the tenth pair of legs, was by accident deprived of the eighth, ninth and tenth pair; at the next change of skin it not only developed two additional pair of legs, but also reproduced the three pair which had been lost. Some time after this it again lost one of the legs of the twelfth pair; a loss which was repaired at the next change by the growth of a new leg, while those previously reproduced acquired an increase of size.

The first observation which led the author to believe that true insects might possess the power of reproducing lost parts, was that of a specimen of Phasma in the collection at the British Museum, in which the right anterior leg had evidently been reproduced. He then instituted a series of experiments on the larva of the *Vanessa urticæ*, or common nettle butterfly, which belongs to the order Lepidoptera, and undergoes complete metamorphosis. He removed some of the true legs of the larva, sometimes in their tibial portion,

and sometimes at their base: in the first case, parts similar to those removed were invariably reproduced in different states of development, and in the latter, entire new limbs were formed; in some instances, at the second change of the larva, when it passed into the pupa state; but in two or three instances no reproduction took place. At first view, this difference in the results might appear to favour the opinion that this reproduction of limbs depends on the existence of parts especially adapted to perform this function, and which, in those experiments that had failed to exhibit the phenomenon, had been themselves removed. But the author found that in every instance of the mutilations thus practised, the perfect insect possessed a coxa, or basilar part of the limb; and this was the case even in those in which a new organ was not reproduced. From this fact, taken in conjunction with the formation of new entire limbs in the Iulidæ after the removal of every portion of the previous ones, the author infers that the power of reproduction resides in the whole of the organized tissues.

The author found that each newly produced limb is, in every case, composed of all its essential parts, namely coxa, femur, tibia, tarsus and claw; but its development is scarcely ever entirely normal, being either deficient in some of the tarsal joints, or irregular in the development of its armature.

The following are the general conclusions which the author deduces from his investigations. Slight wounds in the larvæ of insects always heal, except when the viscera have protruded, or excessive hemorrhage has occurred: severe wounds, such as those attending the excision of a limb, also frequently heal. It is when the wound is in the line of action of the principal muscles of the body that protrusion of the viscera takes place. For the healing of wounds, the first requisite is the arrest of the hemorrhage; and this is effected, as in the higher animals, by the coagulation of the blood, and the formation of a clot; and then a complete union of the separated parts takes place beneath the eschar formed by the clot. After this union, the reparation of the injury is commenced by a development, from the injured surface, of parts corresponding to those that had been removed. For the production of a new limb, one change of skin, at least, is necessary. The healing of the wound after the removal of a part, and the subsequent reproduction, although they do not prevent, yet certainly retard the natural changes. Lastly, the author has established the fact, that reproduction of lost parts takes place in metabolic as well as in the ametabolic articulata.

The paper is accompanied with drawings of reproduced parts.

5. "On the Changes of Temperature produced by the Rarefaction and Condensation of Air." By James Prescott Joule, Esq. Communicated by P. M. Roget, M.D., Sec. R.S.

In order to estimate with greater accuracy than has hitherto been done the quantities of heat evolved or absorbed during the condensation or rarefaction of atmospheric air, the author contrived an apparatus where both the condensing pump and the receiver were

immersed in a large quantity of water, the changes in the temperature of which were ascertained by a thermometer of extreme sensibility. By comparing the amount of force expended in condensing air in the receiver with the quantity of heat evolved, after deducting that which was the effect of friction, it was found that a mechanical force, capable of raising 823 pounds to the height of one foot, must be applied in the condensation of air, in order to raise the temperature of one pound of water one degree of Fahrenheit's scale. In another experiment, when air condensed in one vessel was allowed to pass into another vessel from which the air had been exhausted, both vessels being immersed in a large receiver full of water, no change of temperature took place, no mechanical power having been developed. The author considers these results as strongly corroborating the dynamical theory of the nature of heat, in opposition to that which ascribes to it materiality; but he reserves the further discussion of this question to a future communication, which he hopes soon to present to the Royal Society.

The Society then adjourned over the long vacation, to meet again on the 21st Nov. next.